DESCRIPTION

DIAPHRAGM AND LOUDSPEAKER USING SAME

5 TECHNICAL FIELD

The present invention relates to a diaphragm and a loudspeaker using the same.

BACKGROUND OF THE INVENTION

10 Each loudspeaker generates natural resonance vibration frequency. Therefore, the reproduction level fluctuates extraordinarily at the resonance vibration frequency compared with other frequencies, so that it is difficult to flatten reproduction frequency characteristics. As a result, a signal can not be reproduced appropriately.

15 To solve this problem, Unexamined Japanese Patent Publication No. H7-162992, discloses that the resonance level of a diaphragm at the natural vibration frequency can be suppressed by making the outer periphery of the diaphragm an oval.

As in the example discussed above, making the outer periphery of the 20 diaphragm an oval figure, for example, has a certain effect of suppressing the resonance level at the natural vibration frequency. However, the high resonance level at the natural vibration frequency remains a problem.

SUMMARY OF THE INVENTION

25 One embodiment of the present invention relates to a diaphragm for a loudspeaker that has a shape overlapping a first circle and a second circle in a top view of the outer periphery shape of the diaphragm,

Where in the first circle has a first center point and a first radius, and the second circle has a second center point different from the first center point and a second radius different from the first radius. By forming this shape, signal reproduction characteristics can be significantly flattened.

5

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a sectional view of a loudspeaker in accordance with an exemplary embodiment of the present invention.

Fig. 2 is a plan view of a diaphragm in accordance with the exemplary embodiment of the present invention.

10

Fig. 3 is a plan view showing a shape of the diaphragm in accordance with the exemplary embodiment of the present invention.

Fig. 4 is a signal reproduction characteristic in accordance with the exemplary embodiment of the present invention.

15

REFERENCE MARKS IN THE DRAWINGS

1   frame

2   magnetic circuit

3   magnet

20   4   yoke

5   plate

6   magnetic gap

7   voice coil

9   diaphragm

25   9A   first circle

9B   second circle

9C   third circle

9a, 9b, 9c   center point

10   through-hole

12, 14   edge

12a   cushion part

5   12b, 12c   flange

13   dumper

15   fixing part

100   loudspeaker

10   **DETAILED DESCRIPTION OF THE INVENTION**

Embodiments of the present invention address the difficulty in suppressing fluctuation of the resonance level at a natural vibration frequency in a conventional diaphragm.   For example, in an oval diaphragm, when a plurality of center lines are drawn from an outer periphery to a center

15   point, each center line has a constant distance at the same angle position in right and left directions with respect to the center point.   This is the reason that the resonance level can not be reduced as expected.

Embodiments of the present invention are directed to the shape of a diaphragm's outer periphery.   The shape of the outer periphery of this

20   diaphragm is formed as follows: A first circle and a second circle overlap each other with their center points displaced in such a manner that at least one part of an outer periphery of the first circle and the second circle forms a part of the substantially circular outer periphery of the entire shape of the diaphragm.   Using this shape, most center lines drawn from an edge of the

25   outer periphery to the center point have different distances on a right side and a left side from the center point of the diaphragm.   This can reduce the resonance   level   considerably.   As   a   result,   signal   reproduction

characteristics can be flattened significantly.

Exemplary embodiments of the present invention are demonstrated hereinafter with reference to the accompanying drawings.

Fig. 1 is a sectional view of loudspeaker 100 in accordance with the exemplary embodiment of the present invention. Loudspeaker 100 shown in Fig. 1 accommodates magnetic circuit 2 at an inner bottom surface of dish-shaped frame 1. Magnetic circuit 2 includes magnet 3, yoke 4 and plate 5. Magnetic gap 6 is formed between yoke 4 and a tip of plate 5.

Coil part 8 which is a lower end part of cylindrical voice coil 7 is movably accommodated in magnetic gap 6. In addition, an upper end of voice coil 7 penetrates through-hole 10 of a center of diaphragm 9 and projects upward. Voice coil 7 and diaphragm 9 are fixed at the penetrating position by using an adhesive. Moreover, cap 11 covers an upper end of voice coil 7.

As shown in Figs. 1 and 2, diaphragm 9 has through-hole 10 for fixing voice coil 7 at its center part, and has fixing part 15 of edge 12 at its outer periphery whose shape is substantially circular. The shape of the outer periphery of diaphragm 9 is formed as follows: First circle 9A and second circle 9B overlap each other with their center points 9a and 9b are displaced in such a manner that at least one part of an outer periphery of the first circle and the second circle forms a part of the substantially circular outer periphery of the entire shape.

Using Fig. 3, which illustrates a schematic top view of diaphragm 9, the shape of the diaphragm is described hereinafter in more detail. First circle 9A has radius Ra and center point 9a. Second circle 9B has radius Rb and center point 9b. Third circle 9C has radius Rc and center point 9c, and surrounds first circle 9A and second circle 9B. Further, third circle 9C

contacts an outer periphery of first circle 9A at point Xa on line X-X, and contacts an outer periphery of second circle 9B at point Xb on line X-X. The outer periphery of first circle 9A and the outer periphery of second circle 9B cross each other at point A and point B. A solid line denotes the outer

5   periphery of diaphragm 9. The outer periphery of small circle 9B whose radius is Rb is shown from point A to point B in clockwise direction, and the outer periphery of large circle 9A whose radius is Ra is shown from point B to point A in clockwise direction. Most center lines drawn from the outer periphery of the diaphragm 9 to center point 9c of third circle 9C have

10   different distances on the right side and the left side of center point 9c. For example, distance Lm, which is defined as a distance from center point 9c to the outer periphery of first circle 9A at angle T0 with respect to line Y-Y in a left direction, differs from distance Ln, which is defined as a distance from center point 9c to the outer periphery of second circle 9B at angle T0 with

15   respect to line Y-Y in a right direction. However, distances on the right side and the left side are the same only at center line X-X. This structure significantly reduces the resonance level. As a result, as shown in Fig. 4, the signal reproduction characteristics are flattened (line A) as compared with a conventional diaphragm, shown as line B. Particularly, the frequency

20   characteristic at near 10 kHz is considerably flattened as compared with a conventional diaphragm. In Fig. 4, SPL stands for "output sound pressure level" and is shown as a value of dB.

As shown in Fig. 1, cushion part 12a, which protrudes upward and has a semicircular cross section, form a circular shape as shown in Fig. 2. In

25   addition, circular flange 12b for fixing to frame 1 is formed at an outer periphery of cushion part 12a, and circular flange 12c for fixing to diaphragm 9 is formed at an inner periphery of cushion part 12a.

An end of an inner periphery of ring-shaped dumper 13 is fixed to a lower surface of diaphragm 9, and an end of an outer periphery of dumper 13 is fixed to frame 1 via edge 14.

5   INDUSTRIAL APPLICABILITY

According to a diaphragm of the present invention, signal reproduction characteristics can be flattened as compared with a conventional diaphragm, so that appropriate signal reproduction can be performed in a loudspeaker.

10